Is application rate the only driver of phosphorus phytoavailability in tropical soils receiving mineral and organic fertilizers over an extended period?

NOBILE CM[1,2,3], BRAVIN MN[1,2], BECQUER T[4], PAILLAT JM[2,5]

[1]CIRAD, UPR Recyclage et risque, F-97743 Saint-Denis, La Réunion, France; [2]Recyclage et risque, Univ Montpellier, CIRAD, Montpellier, France; [3]VEOLIA-eau, Saint-Denis, Réunion, France; [4]IRD, UMR Eco&Sols, CIRAD-INRA-SupAgro, F-34060 Montpellier, France;

[5]CIRAD, UPR Recyclage et risque, F-34398 Montpellier, France

E-mail: matthieu.bravin@cirad.fr

Abstract

Application of organic residues (OR) on agricultural soils could reduce the use of mineral phosphorus (P) fertilizers, but the efficiency of OR to meet crop requirements will need to be determined. We thus aimed to study mechanisms determining the effects of OR on P bioavailability to plants (phytoavailability).

Our work was based on five field trials on Reunion Island that included organic and mineral fertiliser applied over a decade, incubations studies and plant growth experiments under controlled conditions. Available inorganic P (Pi) and organic P (Po) was determined using extractions with deionised water and alkaline sodium bicarbonate solution (Olsen), diffusive gradients in thin films technique (DGT) and isotopic dilution associated with anion exchange membranes (EAEM). Phytoavailable P was defined as the P taken up by the plant. Soil Pi sorption capacity was determined using sorption curves.

For all soil types studied (Andosol, Andic Cambisol, Nitisol, and Arenosol), RO mainly increased the available Pi, but had little effect on available Po. This suggests that mineralization of Po applied with RO does not limit Pi availability. Application of RO increased available Pi mainly by increasing soil pH and consequently by decreasing soil Pi sorption capacity. Phytoavailable P increased with soil available Pi, but decreased with increasing soil pH.

Our work suggests that except for the amount of P applied, RO mainly affects P phytoavailability by changes in soil pH.

Keywords: phosphorous, soil P test, organic residue, organic wastes, P availability, soil pH